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Published online: 02 Dec 2021.

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Does fiscal federalism matter for economic growth? Evidence from the United States

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ABSTRACT
Fiscal federalism can improve macroeconomic performance by increasing the efficiency and performance of the public sector. The aim of this study is to analyse the long-term relationship between fiscal federalism and economic growth during the period of 1961–2018 in the United States. In this analysis, first of all, the Hatemi-J Co-integration test was used to determine the long-term relationship between the variables, and accordingly it was determined that there is a long-term relationship between the variables at the 1% significance level. Then, the causality relationship between variables was tested using Hacker–Hatemi-J bootstrap causality analysis and no causality relationship was found among the variables. Finally, a time-varying causality test was applied, since the causality relationship between variables may lose its validity at some time points, especially in global economies. It was found that there is a causality relationship between variables when sub-periods are considered.

I. Introduction

Following the Great Depression in 1929, there was widespread government intervention into economic life, which prevailed until the 1970s. Accordingly, since the 1970s traditional public administration has weakened and been replaced by a more flexible, decentralized, autonomous, transparent, and accountable organizational structure called the New Public Administration approach. At this point, fiscal federalism became an important concept because it essentially means giving more responsibility and authority to subnational governments for their spending and revenue, namely increasing the autonomy of local governments. Moreover, He (2006) indicates that a degree of distribution in the fiscal responsibilities and tasks between different government levels exists generally for institutions and agencies that have been categorized by centrally-administered and locally-administered classification. These institutions or agencies are financially covered mainly by governments at different levels

Although fiscal federalism was initially adopted in the Unites States of America (USA), later on this concept started to gain attention and has been used as a political campaign tool in many countries. It is assumed that fiscal federalism can improve the macroeconomic performance of a country by increasing the efficiency and performance of the public sector owing to the fact that local governments have better knowledge of the regional preferences and needs than the central government.

The most fundamental principle of fiscal federalism is that when local governments decide on the type and quantity of local public goods it is better for the whole economy because local government units can be more responsible and accountable than central government while evaluating regional preferences (Aslim and Neyapti 2014). Fiscal federalism essentially means that the power to make fiscal decisions is placed with multi-level government units (Moges 2013). Fiscal federalism involves the transfer of authority from the national government to the states and local government units. Accordingly, fiscal federalism covers two interrelated areas: the distribution of authority for public revenue and spending among different levels of government and how independent subnational governments are in their decision-making (Kesner-Škreb 2009). The core point of this concept is to give the authority for making

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spending decisions to local governments and accordingly to determine their revenue independently.

Fiscal federalism theory focuses on the distribution of public sector functions and fiscal relations among the layers of government (Bird 1999). The literature divides fiscal federalism approaches into two branches: first- and second-generation fiscal federalism.

First-generation fiscal federalism is shaped by the view of public finance, which is based on the classical normative economics of the 1950s and 1960s. Oates named the first-generation theory as the traditional theory of fiscal federalism (Oates 2005). Regarding the first-generation fiscal federalism theories, it is seen that the studies in the economics literature belong to Tiebout (1956) and Oates (1972) who were the first advocates of the idea that fiscal federalism can affect economic efficiency and thus macroeconomic performance.

Tiebout (1956) introduced mobility of individuals between regions that provide them the best combination of public service and tax. This mobility increases productivity of local governments and contributes to efficient resource allocation since citizens transfer information about their preferences to local governments by *'voting with their feet'*. According to Tiebout's view, local government units compete with each other to provide better and more effective public services, reduce the tax rates which they are responsible for, create a more efficient public sector, and generate fiscal discipline.

According to Oates (1972) if the public goods are supplied by the local governments in line with the preferences of local people, there will be no welfare losses whereas the central government's uniform supply of the public goods. This is called Qates' *'Decentralization Theorem'* in which decentralization of public preferences is Pareto efficient as they prevent consumers' welfare losses.

The traditional approach is based on two strong assumptions. The first assumption is that local governments determine the output of public goods in a way that maximizes the welfare of the voters of the relevant local governments. In other words, these local units are assumed to be benevolent. The second assumption is that every area is treated equally in the provision of local public goods by the central government (uniformity) (Oates 2008).

First-generation fiscal federalism theorists assume that the decentralized systems are benevolent social planners and study their performance. Under this assumption, the traditional view neglects the absolute targets of political authorities who naturally must run for election (Weingast 2014). Accordingly, macroeconomic topics concerning national issues should be left to the authority of the central government. On the other hand, solutions to regional problems and authority for local spending and local revenue should be left to the subnational governments, who have more accurate information about the preferences and wishes of regional people.

According to Brennan and Buchanan's (1980) *'leviathan hypothesis'*, if governments act as revenue maximizers, intergovernmental competition is limited by the budgets they have. The smaller the overall size of the public sector, ceteris paribus, the greater the spread of fiscal decentralization. Thus, fiscal federalism contributes to economic growth by preventing oversupply of public goods or inefficiency.

Second-generation fiscal federalism both builds on the traditional approach and studies the fiscal and political incentives facing subnational units. It has mainly focused on the fiscal and political institutions in order to increase these incentives and to keep the market functioning (Weingast 2014). Therefore, the second-generation theories have moved to interdisciplinary ground through important contributions not only from the economic side but also from political science. This makes it difficult to explain second-generation fiscal federalism systematically and easily, so it would be more appropriate to discuss its origins before its definition (Oates 2005):

(1) Second-generation fiscal federalism works on political economy issues dealing with political processes and the attitudes of officials, along with the public choice theory. Unlike first-generation fiscal federalism, which assumes that public officials' priorities are the public's interests (benevolent), second-generation theories assume that actors (both voters and

politicians) in the political process try to maximize their own interests in a political environment where there are behavioural constraints. In other words, the political officials do not act just to increase the welfare of their voters.

(2) In an environment where there is an asymmetric information problem, some of the participants may have more information on some subjects, such as cost structure or regional preferences, than other participants. Second-generation fiscal federalism underlines the theories of industrial organization and micro economy that study this problem. That is to say, local government units have more knowledge about public services than central government, so this situation will maximize the preferences, wishes, and benefits of residents in their region.

In light of these explanations, we can define the new literature on fiscal federalism. Second-generation fiscal federalism is a new area of fiscal federalism that explores the functioning and mechanisms of different political and fiscal institutions. The fiscal federalism that is examined here focuses on incentives, as well as the behaviours that these incentives cause in participants, in an effort to maximize the benefits in environments with incomplete information and insufficient control.

First-generation literature suggested that revenue generation at the local level should follow the benefit principle, as this increases government accountability and decreases distortions from the taxation of mobile tax bases. Grants are seen as a way to address vertical imbalances and horizontal inequalities, as well as internalize spreads of benefits across regional borders. In contrast, the second generation literature highlights the effects of grants on local incentives on economic growth, rent seeking and budget balance. Moreover, it sees hard budget constraints, limits to issue debt, and bankruptcy laws as tools to discipline and shape the incentive structure of local governments (Martinez-Vazquez, Lago-Peñas, and Sacchi 2016).

One of the basic functions of the public sector is to create public organizations to stimulate economic growth. It is a well-known fact that the average share of central government expenditure

from total government expenditure is generally much higher in developing countries than in developed countries. This fact, combined with the argument in many areas of economic theory favouring decentralized organizations, has recently encouraged the progress of fiscal decentralization in developing countries. On the other hand, the issue of centralization versus decentralization of government is also a relevant economic subject in developed countries. For instance, in Japan, there are discussions on the reform of taxes and intergovernmental grants towards a more decentralized system (Akai, Nishimura, and Sakata 2007). There is a close relationship between fiscal federalism and economic growth. It is unclear why some countries have very developed economies, such as the USA and Switzerland, while others have underdeveloped economies, such as Argentina and Brazil, or why some countries grow rapidly, such as China, while others have low economic growth, for example, Mexico (Weingast 2009). Therefore, the relationship between fiscal federalism and economic growth should be analysed in detail.

In *The Theory of Public Finance*, which is an important book on public economics, Musgrave (1959) introduced three basic branches of public finance: *economic stabilization, income distribution*, and *resource allocation*. Generally, each branch is independently based on persistent theoretical analysis. First of all, in order to have macroeconomic stability in a country, the basic tools of economic policy, which are related to employment, total output, price stability, and money supply, should be under the control of the central government in each country. Therefore, local governments have to rely on the monetary and fiscal policies of the central government. Secondly, an income redistribution policy also has more chance to succeed if it is performed by the national government. The final branch of public economics is resource allocation, where the importance of fiscal federalism appears in the work of the first-generation fiscal federalism theorists (Vo 2008). According to fiscal federalism theory, local governments can access the knowledge of the needs and preferences of regional people at a lower cost and more easily compared with the central government, and the public goods and the services that local governments compete with each other to do the

best. In this context, according to the traditional view, local government units compete with each other to provide more effective and better public goods and services, to reduce the tax rates which they are responsible for, to create a more efficient public sector, and to provide fiscal discipline (Yucel 2007). The traditional economics side of fiscal federalism is based on potential welfare gains from more efficient allocation of resources in the public sector. Local public goods and services are consumed by residents within a certain geographic area. In the federal fiscal system, local government units determine the output level of these public goods themselves, considering local preferences and costs. Such differentiation in the output of local public goods and services causes an increase in economic welfare when compared to an almost identical public output provided by the central government for all regions (Oates 2008). All in all, subnational governments play a major role in providing more efficient resource allocation.

The main argument for fiscal federalism is that it has the potential to increase efficiency in the public sector. There are two concepts of efficiency that can be affected by fiscal federalism. The first one is consumer efficiency. If public spending is done at the subnational level rather than the national level, this may lead to an increase in individual welfare. If consumers in different regions have different preferences or if subnational governments are more responsive to taxpayers' needs and priorities, fiscal federalism may increase consumer efficiency. Secondly, Martinez-Vazquez and McNab (1997) argue that by having better knowledge about individuals' needs and preferences and using that to provide better public services and increased welfare, there will be secondary effects on work effort, savings and investments which may have a positive impact on economic growth. However, the authors acknowledge that the level and combination of public spending that maximizes the welfare of regional citizens will not necessarily have to maximize economic growth over time (Bodman 2008).

Several characteristics of the states and local governments make the studies on this topic important. While the federal government workforce has been shrinking, the states and local governments workforce has been growing over the same period of time. For instance, when looking at the local

public employment, it is large and expanding quickly. There is no doubt that local governments have employed more workers than the federal government and state governments combined over the past sixty years (Shi 2020). This situation makes fiscal federalism important to the economic growth of the country.

The relationship between fiscal federalism and economic growth is a fertile field in which there is already a lot of evidence. In most of the empirical studies, mainly spending then revenue has been used as a measure of decentralization. In this study, spending vs. revenue decentralization have been used at the same time and there are a few studies in literature like this. Baskaran (2014) indicate that despite the fact that there are more cross-country studies than single country studies, overall, the single country studies provide more robust conclusions than the cross-country studies. Therefore, the USA where fiscal federalism was initially adopted has been used as a single country. Moreover, in this analysis, a time-series analysis for the long-term, which allow structural breaks, has been used that is also another contribution of the paper to the literature.

In this study, the importance of fiscal federalism in the world and in the United States has been explained, the theoretical framework of the fiscal federalism has been examined in detail and the relationship between fiscal federalism and economic growth has been analysed in the introduction section. Secondly, in the section of 'Literature Review ", the relationship between fiscal federalism and economic growth will be analysed by the means of a table summarizing the literature, indicating the method used, country names, periods and the main conclusions. The variables and the model are analysed in "Econometric Analyses and Methodology" section. In the analyses, a time-series analyses for the long-term, which allow structural breaks, between the variables of fiscal federalism and economic growth is examined. The ratio of local governments" revenue to GDP or local governments' spending to GDP for the USA is used as a measure of fiscal federalism and real GDP growth in the USA is used as proxy for economic growth in the period from 1961 to 2018. Firstly, the Lee–Strazicich unit root test, which allows two structural breaks for the stability of the

series, is used. Secondly, the Hatemi-J co-integration test, which allows two structural breaks, is used to determine the long-term relationship between the variables. After the co-integration tests, the causality relationship between variables is tested by Hacker–Hatemi-J bootstrap causality analysis. Finally, since the causality relationship between variables may lose its validity at some time points, we also apply a time-varying causality test in this study.

II. Literature review

In theoretical studies, it is possible to obtain arguments that fiscal federalism can positively affect economic growth. On the other hand, no precise consensus has developed in the empirical literature over the direction and strength of this relationship between the structure of government and economic growth (Bodman, Heaton, and Hodge 2009a). Most of the academic research on the relationship between fiscal federalism and the various macroeconomic variables focuses on the relationship between fiscal federalism and economic growth. The majority of empirical studies for single countries have mixed results, but it can be said that, albeit a small difference, more studies found a positive impact of fiscal decentralization on economic growth than found a negative impact or no relation between them.

If fiscal decentralization has positive impact on economic growth in a country, a conspicuous question is which role local governments should play for the economic development of a country as a whole. Empirical studies can therefore be distinguished in single-country and cross-country studies. Studies analysing the effects of fiscal federalism on economic growth for a single country have mainly focused on the USA, China, India, Ukraine, Russia, Switzerland, Spain, and Germany (Baskaran 2014). Some of these studies are conducted at the national level and some of them are conducted at the level of states or local governments. Accordingly, we will focus on studies historically that analyse the relationship between fiscal federalism and economic growth for a single country at Table 1.

III. Econometric analyses and methodology

In the analysis part of this study, our hypothesis that 'there is a long-term relationship between fiscal federalism and economic growth' will be tested for the USA economy by structural break econometric models. The starting point for this analysis is whether determinants of fiscal federalism affect economic growth in the USA due to the fact that the USA's economic growth is very important for local, central, and global economic dynamics and also a slowdown in the USA's economic growth has a negative influence worldwide. Therefore, economic policy proposals will be made after determining whether there is a long-term relationship between fiscal federalism and economic growth.

The methodology used in this analysis is structured as follows:

- The model is established by introducing the data set;
- Unit root tests, which allow structural breaks in the established model, are implemented;
- The Hatemi-J co-integration test, which allows structural breaks, is used;
- Hacker–Hatemi-J bootstrap causality analysis is carried out;
- A time-varying causality test is applied.

Data set and the model

The number of studies on the relationship between fiscal federalism and different macroeconomic indicators has been increasing recently. Most of them are cross-country analyses using the Government Finance Statistics (GFS) from the International Monetary Fund, and these studies mostly define the degree of fiscal federalism as the local governments' spending or revenue as a proportion of total spending/revenue or GDP. Comparing the degree of fiscal decentralization across countries is a complex issue because there is no unique and single measurement of fiscal federalism and it requires description of subnational autonomy and authority over spending and revenue arrangements. Although it is generally accepted that local governments' spending or revenue as a proportion of total spending/

Table 1. Important empirical studies on the effect of fiscal federalism on economic growth in countries.

Study	Country	Period	Method	Main Results
Xie, Zou, and Davoodi (1999)	Central level in the United States	1951–1992	Time series analysis, OLS	No significant impact of spending decentralization on growth of real GDP per capita
Lin and Liu (2000)	28 Chinese provinces	1970–1993	Fixed effect models, time dummies	Revenue decentralization increases growth of real GDP per capita
Zhang and Zou (2001), Sample 1	29 Chinese provinces	1987–1993	OLS, fixed effects	Decentralization decreases economic growth
Zhang and Zou (2001), sample 2	16 Indian states	1970–1994	OLS	Decentralization increases economic growth
Akai and Sakata (2002)	50 U.S. States	1992–1996	OLS and fixed effects model, time dummies	Spending decentralization increases growth of GDP per capita
Naumets (2003)	24 Ukrainian oblasts and autonomous Republic of Crimea	1998–2000	Fixed effects and random effects models	Not strong negative impact of own revenue decentralization on growth of real gross value added
Feltenstein and Iwata (2005)	Central level in China	1952–1996	VAR with time series data	Fiscal decentralization has negative impacts on macroeconomic stability but tends to boost economic growth
Jin and Zou (2005)	30 Chinese provinces	1979–1999	Fixed effects with corrected standard errors	Divergence between local expenditures and revenue increases economic growth
Stansel (2005)	314 U.S. metropolitan areas	1960–1990	Robust OLS	Higher fragmentation is related with significantly higher growth
Jin, Qian, and Weingast (2005)	29 Chinese provinces	1982–1992	Fixed effect models, time dummies	Expenditure decentralization increases growth of real GDP per capita
Desai, Freinkman, and Goldberg (2005)	80 Russian regions	1996–1999	OLS with panel corrected standard errors, TSLS	Decentralization has a positive but nonlinear effect on growth
Gil-Serrate and López-Laborda (2006)	Spain 17 regions	1984–1995	Fixed effects and random effects modelling of time series	Fiscal decentralization has positive effect on economic growth
Akai, Nishimura, and Sakata (2007)	50 U.S. States	1992–1997	Maximum likelihood method	Hump-shaped relationship between decentralization and economic growth
Qiao, Martinez-Vazquez, and Xu (2008)	28 Chinese provinces	1985–1998	TSLS with pooled data	Expenditure decentralization increases growth of nominal GDP per capita
Bodman et al. (2009b)	Australia	1972–2005	Time series analysis, OLS	Fiscal decentralization does not affect economic growth in the short-term
Dang (2013)	Nigeria	1993–2012	Time series Co-integration and Error Correction Model (ECM)	Revenue allocations have significant causal relationship with economic development with only revenue allocation to states having significant negative relationship
Yushkov (2015)	Russia 78 regions	2005–2012	Panel data model	The effect of fiscal federalism on regional economic growth is significantly negative
Sylvester and Ade (2017)	Nigeria	1984–2015	Johansen Co-integration Test and Error Correction Model (ECM)	Revenue allocation to states increases economic growth but revenue allocation to local governments decreases

revenue or GDP is not a perfect measure of fiscal federalism, many researchers use these measurement methods to represent the degree of fiscal federalism (Ebel and Yilmaz 2002). Accordingly, the important point in analysing the impact of fiscal federalism on economic factors statistically is the measurement of fiscal federalism as *a numerical expression*. To measure the level of fiscal federalism, the degree of distribution of authority to local governments or the level of their powers must be known. On the other hand, measuring the authority of governments is quite difficult quantitatively (Akai and Sakata 2002).

The measurement of fiscal federalism is unfortunately multidimensional and complex. First of all, the formal division of spending and revenue between levels of government is important. Secondly, decentralized fiscal decision-making also determines the scope of fiscal federalism (Bodman 2008). Hence, there is no simple and unique measurement of fiscal federalism.

In particular, the empirical studies on this issue use different measurements for the fiscal federalism variables. The debate over how to measure fiscal decentralization is ongoing. Various authors have used different methods to measure fiscal federalism:

- Local revenue/GDP;
- Local spending/GDP;
- Local revenue/total revenue;
- Local spending/total spending;

- Local tax revenue/total tax revenue;
- Local tax revenue/total revenue;
- The number of local governments.

Last of all, in this study, we use 'local spending/GDP' and 'local revenue/GDP' as the measurements of fiscal federalism.

In this study, annual data for the USA economy during the period of 1961–2018 were used. 'Economic Growth' was used as a dependent variable in the model while 'local spending/GDP' and 'local revenue/GDP' were used as independent variables. In addition, since the inflation variable is effective on both economic growth and fiscal federalism, it is included in the model as a control variable. Logarithmic forms were not used since all variables included in the analysis are ratios.

Table 2 shows the variables included in the analysis, which are 'Economic Growth' of the USA as a dependent variable, 'local spending/GDP' and 'local revenue/GDP' of the USA as independent variables and 'inflation' as a control variable, represented respectively by GRO, SPE, REV, and INF. Economic growth and inflation data are obtained from the World Bank website, local governments' spending and revenue data are obtained from the US Census Bureau website.

Figure 1 shows the variables that are used in this analysis for the period of 1961–2018.

According to the hypothesis mentioned above, the basic model is determined as follows

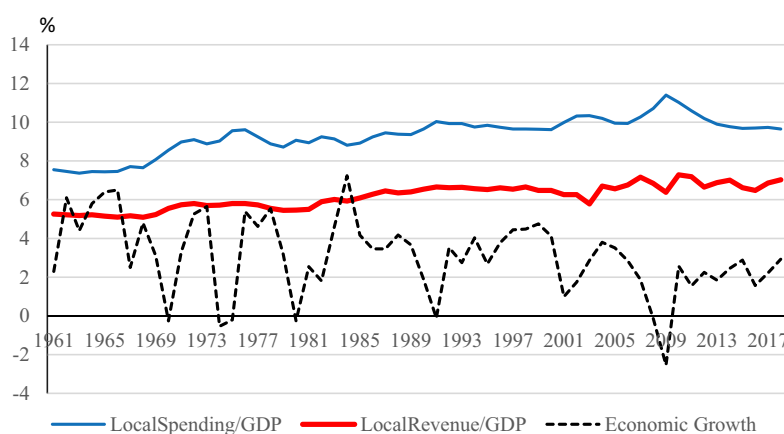$$GRO_t = \beta_0 + \beta_1 SPE_t + \beta_2 REV_t + \beta_3 INF_t + \varepsilon_t$$

Figure 1. Fiscal federalism and economic growth data of the USA. **Sources**: World Bank, US Census Bureau

Table 2. Data set and sources.

Variable	Abbreviation	Source
Economic growth	GRO	World Bank
Local spending/GDP	SPE	US Census Bureau
Local revenue/GDP	REV	US Census Bureau
Inflation	INF	World Bank

Method and results

A time-series analysis that allows structural breaks was used in this study. At the beginning of the analysis, we used the Lee–Strazicich unit root test, which is the most preferred test in the literature and allows structural breaks and in which the stationary degrees of the series are tested. After the stationary test, the Hatemi-J multiple structural breakage co-integration test and the Hacker–Hatemi-J bootstrap causality tests were used to analyse whether there is a long-term co-integration relationship between the variables. Finally, we applied the Time-Varying Causality test.

Unit root test results

In the time-series analysis, the unit root problem should be tested in order to eliminate the fake regression problem. Stability tests that are performed with appropriate unit root tests prevent the fake results of the analysis performed with a non-stable series. As a result of the tests, it was concluded that if the series containing unit root are not stable and the non-stationary time-series do not have a co-integration relationship, it would be a mistake to talk about the existence of a meaningful economic relationship between the variables (Harris and Sollis 2003).

The time series can be stationary around different deterministic trends in different periods. These differences may result from structural breaks occurring in constant term and/or slope. Events such as war, natural disasters, peace, policy changes, terrorist attacks, and economic crises may cause these breaks. Carrying out a unit root test analysis without taking into account these structural breaks can give invalid results that suggest that a series that is actually stationary is not stationary. In this context, Lee and Strazicich (2003) developed a unit root test that searched for the presence of two structural breaks in the series. Model A searches for the existence of two structural breaks in the average of the series, while Model C searches for the existence of two structural breaks in the average and trend of the series. If the absolute value of the obtained test statistics is greater than critical values, the hypothesis of the structural breaks unit root is rejected and if it is smaller than the critical values, it is not rejected. Equations (1) and (2) show the equations for Model A and Model C, respectively.

Model A

$$\Delta y_t = K + \emptyset y_{t-1} + \beta t + \theta_1 DU1_t + \theta_1 DU2_t$$
$$+ \sum_{j=1}^{k} dj\Delta y_{t-j} + \varepsilon_t \quad (1)$$

Model C

$$\Delta y_t = K + \emptyset y_{t-1} + \beta t + \theta_1 DU1_t + \theta_2 DT1_t$$
$$+ \theta_2 DU2_t + \gamma DT_t + \sum_{j=1}^{k} dj\Delta y_{t-j} + \varepsilon_t \quad (2)$$

$$DU_t = \left(\begin{matrix} 1 - t > TB \\ 0 \rightarrow Diger \end{matrix} \right) \quad (3)$$

$$DU_t = \left(\begin{matrix} t - TB \rightarrow t > TV \\ 0 \rightarrow Diger \end{matrix} \right) \quad (4)$$

Δ denotes the first difference operator; ε_t denotes the error term and has white noise if it is used with the variance term (σ^2) and lastly $t = 1 \ldots T$ denotes the time. The Δy_{t-j} term ensures that the error term is white noise and is not autoregressive. DU_t is the dummy variable. Model A's null hypothesis states that the series is not stationary with a single break in level, while the alternative hypothesis states that the series is stationary with a single break in level. On the other hand, the null hypothesis of Model C indicates that the series is not stationary with a single break in level and slope, while the alternative hypothesis indicates that the series is stationary with a break in level and slope.

In this study analysing the relationship between fiscal federalism and economic growth, the variables included in the model have unit root for both Model A and Model C according to the Lee–Strazicich test. According to Table 3., it can be said that both the REV and SPE variables are stationary at the level of 1% for Model

A and INF variable is stationary at the level of 1% for Model C. The most commonly used method to make the unit rooted series stationary is to take the difference of the series from the first degree. In this context, the stationary analysis is done again by taking the difference of the series from the first degree.

Table 4. indicates that, when the difference of the variables included in the model is taken, it is concluded that the test statistic values for all variables are stationary with the structural break, since the absolute value is greater than the critical values at the significance level of 1%.

The results of the stationary analysis showed whether the effect of an economic shock in the USA economy on fiscal federalism was permanent or temporary and appropriate policies are developed accordingly. According to the results of the analysis, it can be said that if the series is stationary in level value and there is a shock to the series, this shock will create temporary effects. However, if the series has unit root in level and it becomes stationary in the first degree, then it is interpreted that the effect of the shock will be permanent in the long term (Lee and Chang 2008).

In 1978 and 1980, the aggregate supply curve shifted to the left because not only did the price of petroleum double but inflation and unemployment rates in the USA also increased. The federal reserve increased interest rates in the period from 1979 to 1981 in order to reduce inflation and in 1981–1982 there was a period of recession. In this period, the total goods and services produced in the USA economy decreased and the unemployment rate exceeded 10%. After 1982, the economy started to expand rapidly. In 1990–1991, the USA economy was again in recession. This recession was expressed with unprecedented stagnation after World War II, and it was very difficult to get credit at that time. The USA economy was shaken by a series of shocks related to total demand in the early 2000s. The 'technology bubble' explosion in March 2000 is the most important of these shocks. The stock market fell sharply and this shock reduced households' and companies' spending, causing a decrease in aggregate demand (AD) and shifting the AD curve to the left (Mishkin 2007).

Hatemi-J co-integration test

In econometric studies, co-integration tests are applied to analyse whether variables move together in the long term. In this study, the Hatemi-J Co-Integration test, which allows structural breaks in co-integration tests, is used. Hatemi-J (2008) carried out the co-integration test, which had been previously developed by Gregory and Hansen (1996) for the existence of a single structural break, to allow two structural breaks. In his study, Hatemi-J (2008) expressed the effect of two structural breaks at both constant and slope considering equation (5) below:

$$y_t = \alpha_0 + \alpha_1 D_{1t} + \alpha_2 D_{2t} + \beta 0 x_t + \beta 1 D_{1t} x_t + \beta 2 D_{2t} x_t + u_t$$

α_0 is the constant term before structural changes in the equation, α_1 indicates the first structural break, and α_2 is the change in the constant term due to the second structural break. β_0 is the slope parameter before the structural break, β_1 indicates the effect created by the first structural change at the slope, and the β_2 parameter demonstrates the effect created by the second structural break. y_t is the dependent variable and x_t is the independent variable vector. In the model, if $t > [n\tau_1]$ then $D_{1t} = 1$, if not 0; if $t > [n\tau_2]$ then $D_{2t} = 1$, if not 0 are

Table 3. Lee–strazicich unit root test results.

Variables	Model A			Model C		
	T-statistics	First Break	Second Break	T-statistics	First Break	Second Break
GRO	−3.19 (8)	2000	2009	−5.67(8)	1990	2009
SPE	−5.61(8)*	1981	2010	−5.47 (8)	1981	2007
REV	−5.06(8)*	1981	1998	−5.92(8)	1981	1997
INF	−3.51(1)	1973	1982	−8.15(1)*	1977	1983
Critical	−4.07(1%)			−7.00 (1%)		
Values	−3.56(5%)			−6.18 (5%)		

Values given in parentheses indicate the delay lengths. *, **, and *** indicate 1%, 5% and 10% significance levels, respectively. The critical values are taken from Lee and Strazicich (2003) Table 2, pp. 1084.

Table 4. Lee–Strazicich unit root test results (difference taken).

Variables	Model A			Model C		
	T-statistics	First Break	Second Break	T-statistics	First Break	Second Break
ΔGRO	−7.53(3)*	1978	1998	−8.44(3)*	1999	2005
ΔSPE	−5.23(1)*	1980	1982	−7.75(8)*	2004	2007
ΔREV	−8.02(1)*	1980	2007	−8.43(1)*	1978	2000
ΔINF	−8.55(1)*	1978	1981	−7.70(3)*	1976	1982
Critical	−4.07(1%)			−6.96 (1%)		
Values	−3.56(5%)			−6.20 (5%)		

Values given in parentheses indicate the delay lengths. *, **, and *** indicate 1%, 5% and 10% significance levels, respectively. The critical values are taken from Lee and Strazicich (2003) Table 2 at pp. 1084.

dummy variables as defined. The terms τ_1 and τ_2 refer to unknown indicators that display structural break times, ranging from 0 to 1 (Hatemi-J 2008). In the Hatemi-J test, test statistics ADF*, Z_t and Z_α are used to test the basic hypothesis, which shows that there is no co-integration relationship between variables (Yilanci and Ozturk 2010).

According to the results of the Hatemi-J structural break co-integration test, as demonstrated in Table 5., the ADF test statistics are higher than the absolute value of the Hatemi-J (2008) critical values at the 1% significance level. Therefore, it is concluded that the hypothesis that there is no long-term co-integration between fiscal federalism and economic growth in the USA economy should be rejected and the variables included in the analysis are co-integrated with two structural breaks.

On 15 October 1973, OPEC declared an oil embargo in response to the USA's support of the Israeli Army in the Yom Kippur War and said that it will no longer export oil to the countries that sided with the USA and Israel in the war. After that OPEC member countries decided to increase oil prices to raise revenues of their countries. This skyrocket in oil prices in 1973 caused a collapse of the stock market and a global economic crisis. In 1976, the democratic governor Jimmy Carter won the popular vote at the 48th quadrennial presidential election of the United States and South Vietnam and North Vietnam were formally united.

According to the results obtained from the analysis, revenue and spending variables, which are included in the model as indicators of fiscal federalism and economic growth, act together by taking into account the structural breaks in the long run. In other words, there is a long-term balance relationship between the variables.

Hacker–Hatemi-J Bootstrap causality test

In the Hacker and Hatemi-J (2006) Granger causality test, the Toda–Yamamoto causality test (1995) is used to determine the causality between variables, but critical values are obtained with bootstrap in spite of a possible risk of non-normally distributed errors. However, the missing point of this model is that it cannot distinguish between positive and negative shocks. In this context, the Hatemi-J asymmetric causality test (2012) is formed from a decomposed version of the positive

Table 5. Hatemi-J co-integration test results.

ADF*		Z_t		Z_a	
Test Statistics	Break Period	Test Statistics	Break Period	Test Statistics	Break Period
−11.93(0)*	1973, 1976	−12.03*	1973, 1976	−83.12*	1972, 1976
Critical Values		Critical Values		Critical Values	
1%	5%	1%	5%	1%	5%
−6.92	−6.45	−7.88	−7.35	−99.45	−83.64

Critical values are taken from Hatemi-J's (2008) study. The values in parentheses indicate the length of the delay. The number of lags in the model is calculated as 10 according to Schwert's formula (1989).

and negative shocks of the Hacker and Hatemi-J (2006) Granger causality test. Assuming that the causality analysis is between two integrated series, such as y1t and y2t, the Hacker and Hatemi-J Causality test can be summarized as follows:

$$y_{1t} = y_{1t-1} + \varepsilon_{1t} = y_{10} + \sum_{i=1}^{t} \varepsilon_{1i} \qquad (6)$$

$$y_{2t} = y_{2t-1} + \varepsilon_{2t} = y_{20} + \sum_{i=1}^{t} \varepsilon_{2i} \qquad (7)$$

It shows the starting values of y10 and y20 in the model. The positive and negative shocks used in the test are as follows:

$$y_{1t} = y_{1t-1} + \varepsilon_{1t} = y_{10} + \sum_{i=1}^{t} \varepsilon_{1i} + \sum_{i=1}^{t} \varepsilon_{1i}^{+}$$

$$y_{2t} = y_{2t-1} + \varepsilon_{2t} = y_{20} + \sum_{i=1}^{t} \varepsilon_{2i} \sum_{i=1}^{t} \varepsilon_{1i}^{-}$$

The positive and negative shocks in the variables are finally shown in the cumulative form as follows:

$$y_{1i}^{+} = \sum_{i=1}^{t} \varepsilon_{1i}^{+}, y_{1i}^{-} = \sum_{i=1}^{t} \varepsilon_{1i}^{-}, y_{2i}^{+} = \sum_{i=1}^{t} \varepsilon_{2i}^{+}$$

According to Table 6., which includes the results of the Hacker–Hatemi-J bootstrap causality test, since the test statistic values are less than the critical bootstrap values, there is no two-way causality relationship between fiscal federalism and economic growth and the basic hypothesis of H_0, established as *'there is no causality relationship between variables'*, is accepted. However, there is

a causality relationship at the 1% significance level from the inflation to the growth, which is included in the model as a control variable.

The existence of a co-integration relationship between variables in the model does not indicate that there is a causality relationship. According to the analysis, there is no one-way or two-way causality relationship between economic growth, spending, and revenue variables in which there is a long-term equilibrium relationship.

Table 6. Hacker and Hatemi-J Bootstrap causality test.

Basic Hypothesis	Test Statistic	Critical Values		
		1%	5%	10%
DGRO≠>DREV	8.74	29.958	21.080	17.503
DREV≠>DGRO	8.393	31.159	23.136	19.167
DSPE≠>DGRO	13.09	28.014	21.103	17.758
DGRO≠>DSPE	13.58	29.929	20.482	17.734
DSPE≠>DREV	6.73	34.292	22.295	18.762
DREV≠>DSPE	11.83	32.433	22.388	18.808
DGRO≠>DINF	3.50	9.631	6.339	4.884
DINF≠>DGRO	14.954	9.005	5.448	4.352

Time-varying causality test

In socio-economic analyses, the causality relationship between variables is usually done with standard tests. In these tests, analyses are carried out with causality methods that examine the entire period as a whole. However, especially in global economies, the causality relationship between variables may lose its validity at some points throughout the period. Political and economic developments in the markets can affect many macroeconomic variables and this effect may vary over time. For the stated reasons, we also applied a time-varying causality test in this study. The advantages of the time-varying causality test can be summarized as follows:

- It focuses on the intertemporal change in the causality relationship between variables.
- It provides information about the level of stability of the ongoing causality relationship between variables.

The time-varying causality test used in the study is based on the Toda and Yamamoto (1995) causality test developed by Hacker and Hatemi-J (2006). The co-integration or stability of the series is not dealt with in the Toda–Yamamoto test; rather, it is assumed that the residuals of the model are normally distributed. In the Hacker–Hatemi-J causality test, this problem is solved with the bootstrap method. The time-varying causality test is a version of the Hacker–Hatemi-J causality approach applied to each sub-period.

The basic equation that is used to calculate the bootstrap LR Granger statistic, used in the study, includes a VAR(p) process as follows (Manga, Destek, and Duzakin 2016)

$$Z_t = \phi_0 + \phi_1 Z_{t-1} + \ldots + \phi_p Z_{t-p} + \varepsilon_t t$$
$$= 1, 2, \ldots T$$

P is the length of the delay and $\varepsilon_t = (\varepsilon_{1t}, \varepsilon_{2t})$, refers to a white noise process with a zero average. The critical values of the test are obtained using the regulated form of the Toda and Yamamoto (1995) causality test, which can be also used for non-co-integrated series according to the bootstrap approach developed by Efron (1979). On the other hand, the time-varying bootstrap causality test developed by Balcilar, Ozdemir, and Arslanturk (2010) divides the sample into sub-samples like $t = \tau - l + 1, \tau - 1, \ldots \tau$, and $\tau = l, l + 1, \ldots T$, thus allowing the intertemporal causality relationship to be examined. In this study, probability values were obtained after 10,000 repetitions and a trimaj rate of 15% was used, similar to in the studies by Balcilar, Ozdemir, and Arslanturk (2010) and Aye et al. (2014).

In this study, the causality relationship between fiscal federalism and economic growth is analysed with time-varying symmetric methods, the blue lines in Figure 2 show the periodically calculated test statistic value of the hypothesis, while the red straight line represents the critical value of the test. According to Figure 2., there is a causality relationship between the variables in the intervals where the blue line is above the red line. From examining the graphs, we can note the following points:

- There is a causality relationship from the spending variable to the economic growth variable in 1984 and 1988. In these specific periods, developments on the spending side are associated with economic growth.
- There is a causality relationship from the economic growth variable to the spending variable in the period of 1988–1991. The
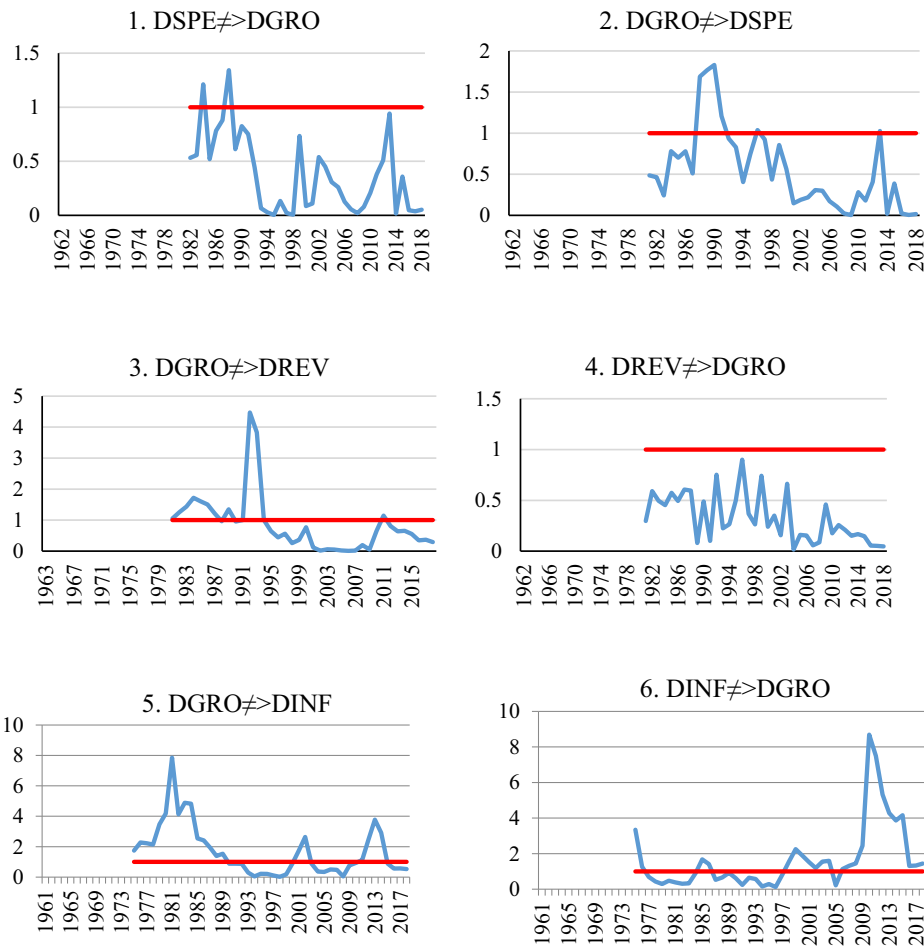
Figure 2. Time-varying causality relationship.

developments in economic growth are associated with spending in these periods. There is a two-way relationship between spending and economic growth, but the interaction times are different.

- There is no causality relationship from revenue variable to economic growth.
- There is a causality relationship from the economic growth variable to the revenue variable in 1981–1987, 1989, 1991–1994, and 2011. During these periods, changes in economic growth affect revenue. Therefore, there is a one-way causal relationship between revenue and growth.
- There is a causality relationship from the economic growth variable to the inflation variable in 1975–1991, 1989, 2001–2003, and 2011–2015.

- There is a causality relationship from the inflation variable to the economic growth variable in 1975–1977, 1984–1987, 1998–2004, and 2005–2018.

IV. Concluding remarks

In this study, we analysed the relationship between fiscal federalism and economic growth in the USA between 1961 and 2018. Firstly, we found that the series is stable at the level of I(1) by using the Lee–Strazicich unit root test. Then, the Hatemi-J cointegration test was used to determine the long-term relationship between the variables, and we concluded that there is a long-term relationship between the variables at the 1% significance level. Finally, we investigated whether there is a causality

relationship between variables. According to the results of the Hacker and Hatemi-J bootstrap causality test, which we applied to analyse the relationship between fiscal federalism and economic growth for whole the period of 1961–2018, there is no two-way causality relationship between variables. On the other hand, when the time-varying causality test was used to analyse this relationship, it could be seen that there is a causality relationship between variables when sub-periods are considered. The time-varying causality test shows that there are causality relationships from the spending variable to the economic growth variable, from the economic growth variable to the spending variable, and from the economic growth variable to the revenue during some periods in the period of 1961–2018, but there is no causality relationship from the revenue variable to the economic growth variable.

Theoretically, there is a relationship between fiscal federalism and economic growth. On the other hand, the majority of empirical studies on the impact of fiscal federalism on economic growth for single countries have mixed results. Albeit a small difference, more studies found a positive impact of fiscal decentralization on economic growth than found a negative impact or no relation between them. Overall, based on empirical evidence from the results, our study reveals that local governments in the USA should be given some degree of autonomy in their fiscal decisions, especially for spending, since there is a relationship between fiscal federalism in terms of spending decentralization and economic growth during some periods. Accordingly, efficiency, transparency, and accountability at all levels of government enables the federal units to achieve both national and regional goals and objectives.

In summary, we can suggest that the relationship between fiscal federalism and economic growth should be analysed for different countries or country groups. This interesting approach would gain more with a dynamic panel data model in subsequent studies to obtain reliable results.

Disclosure statement

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